WHAT IS CLAIMED IS:

5

      1.   A method of recognizing a document image including a plurality of areas, comprising the steps of:

      a) inputting said document image as a digital image;

10   b) specifying a background color of said document image;

      c) extracting a plurality of pixels located in areas other than a background area from said document image by use of said background color;

15   d) creating a plurality of connected elements by combining said plurality of pixels; and

      e) classifying said plurality of connected elements into a plurality of fixed types of areas by using at least features of shapes of said plurality of

20 connected elements to obtain an area-separated document image.

25

2. The method as claimed in claim 1, further comprising the steps of:

f) creating a binary image by binarizing said area-separated document image;

5 g) classifying a plurality of areas included in said binary image into said plurality of fixed types of areas;

h) comparing a result of the step (e) and a result of the step (g);

10 i) correcting said area-separated document image if said result of the step (e) is not equal to said result of the step (g); and

j) recognizing a character in a text area of said area-separated document image.

15

3. The method as claimed in claim 1, wherein 20 said step (b) includes the steps of:

k) clustering a plurality of colors on said document image; and

l) setting a representative color of a largest cluster obtained by the step (k) to said background 25 color.

4.   The method as claimed in claim 3, wherein said step (k) includes the steps of:

sampling each of the plurality of pixels at regular intervals; and

5   clustering the plurality of colors on said document image by use of a plurality of pixel values obtained by smoothing pixels surrounding said each of the plurality of pixels.

10

5.   The method as claimed in claim 1, further comprising the step of reducing a size of said document

15   image, wherein said step of reducing the size of said document image includes the steps of:

diving said document image into a plurality of blocks;

obtaining a representative color of each of

20   said plurality of blocks;

determining colors of said plurality of blocks after sizes of said plurality of blocks are reduced, by comparing said representative color and said background color; and

25   reducing said plurality of blocks into the

plurality of pixels having said colors.

5

     6.   The method as claimed in claim 5, wherein said each of the plurality of blocks is a 3×3 or 4×4 grating.

10

     7.   The method as claimed in claim 1, wherein said step (c) includes the step of determining a focused

15   pixel as a pixel located in an area other than said background area if a difference between three primary colors of said background color and said focused pixel is larger than a fixed value.

20

     8.   The method as claimed in claim 1, further comprising the steps of:

25   creating the document image, in which a figure

or photograph rectangular area separated by said step

(e) is painted over with a specified color;

binarizing said document image; and

recognizing characters on a binary image

5   obtained by binarizing said document image.

10   9.   The method as claimed in claim 1, further

comprising the step of recursively performing said step

(e) to a specific rectangular area classified at said

step (e).

15

        10.   A method of recognizing a document image,

comprising the steps of:

20   a) inputting said document image as a digital

image;

        b) performing color area separation to said

document image;

        c) creating a binary image for each area

25   separated by said color area separation;

d) creating a single binary image by combining said binary image for each area, thereby performing binarization to said document image;

e) performing binary area separation to said

5   single binary image;

f) comparing a result of said color area separation and a result of said binary area separation; and

g) obtaining a binary image and a result of

10   area separation by performing a feedback process until a certain condition is satisfied, or for a fixed times, in accordance with a result of the step (f).

15

11.   The method as claimed in claim 10, wherein said feedback process is performed in a case in which the certain condition is not satisfied in a range

20   of said document image as the result of the step (f), said feedback process including the steps of:

creating an area that includes said range;

performing said color area separation, said binarization and said binary area separation to said

25   area; and

performing said step (f).

5

12.   The method as claimed in claim 10,
wherein said feedback process is performed in a case in
which a text line is extracted from a range in said
document image by one of said color area separation and
10   said binary area separation, and a character rectangle
including characters is not extracted from said range by
the other, said feedback process including the steps of:
specifying a character color of said character
rectangle;
15   determining that said range includes a
character if said character color is even throughout
said range;
performing said color area separation, said
binarization, said binary area separation to said range
20   by use of said character color; and
performing said step (f).

25

13.   The method as claimed in claim 12,
wherein said feedback process includes the steps of:

creating an area including the text line in a
case in which said text line extracted from the range by
5   said color area separation does not exist in the result
of the binary area separation as the result of said step
(f);

performing said binarization and said binary
area separation to said area; and
10   performing said step (f).

15   14.   The method as claimed in claim 10,
wherein said feedback process is performed in a case in
which layout features of a fixed number or more than the
fixed number of text lines are continuously different
between said result of the color area separation and
20   said result of the binary area separation as the result
of said step (f), said feedback process including the
steps of:

creating an area including said text lines;
binarizing said area;
25   performing said binary area separation to said

area; and

performing said step (f).

5

15. The method as claimed in claim 10, wherein an image-division-type binarizing method is applied to a text area of said document image, and a

10 discriminant analysis method is applied to ruled-line, figure, and photograph areas.

15

16. The method as claimed in claim 10, wherein said color area separation includes the steps of:

specifying a background color of said document

20 image;

extracting a plurality of pixels located outside a background area from said document image by use of said background color;

creating a plurality of connected elements by

25 combining said plurality of pixels; and

classifying said plurality of connected

elements into a plurality of fixed types of areas by use

of at least features of shapes of said connected

elements to obtain an area-separated document image.

5

17.   A document-image recognition device

10   recognizing a document image including a plurality of

areas, comprising:

an input unit inputting said document image as

a digital image;

a background-color specifying unit specifying

15   a background color of said document image;

an extracting unit extracting a plurality of

pixels located outside a background area from said

document image by use of said background color;

a creating unit creating a plurality of

20   connected elements by combining said plurality of

pixels; and

a classifying unit classifying said plurality

of connected elements into a plurality of fixed types of

areas by use of at least features of shapes of said

25   connected elements to obtain an area-separated document

image.

5

18. The document-image recognition device as claimed in claim 17, further comprising:

a binary-image creating unit creating a binary image by binarizing said area-separated document image;

10 a correcting unit classifying a plurality of areas included in said binary image into said plurality of fixed types of areas, and correcting said area-separated document image by comparing said area-separated document image with a result of classifying

15 the plurality of areas; and

a recognizing unit recognizing a character in a text area of said document image.

20

19. The document-image recognition device as claimed in claim 17, wherein said background-color specifying unit includes:

25 a clustering unit clustering a plurality of

colors on said document image; and

a setting unit setting a representative color of a largest cluster obtained by clustering said plurality of colors on said document image to said

5   background color.

10   20.   The document-image recognition device as claimed in claim 19, wherein said clustering unit includes:

a sampling unit sampling the plurality of pixels at regular intervals; and

15   a cluster unit clustering the plurality of colors on said document image by use of a plurality of pixel values obtained by smoothing pixels surrounding said plurality of pixels.

20

21.   The document-image recognition device as claimed in claim 17, further comprising a reducing unit

25   reducing a size of said document image, wherein said

reducing unit includes:

a dividing unit diving said document image into a plurality of blocks;

a representative-color obtaining unit

5   obtaining a representative color of each of said plurality of blocks;

a color determining unit determining colors of said plurality of blocks after sizes of said plurality of blocks are reduced, by comparing said representative

10   color and said background color; and

a block reducing unit reducing said plurality of blocks into the plurality of pixels having said colors.

15

22.   The document-image recognition device as claimed in claim 21, wherein each of said plurality of

20   blocks is a 3×3 or 4×4 grating.

25   23.   The document-image recognition device as

claimed in claim 17, wherein said extracting unit

includes a pixel determining unit determining a focused

pixel as a pixel located outside said background area if

a difference between three primary colors of said

5   background color and said focused pixel is larger than a

fixed value.

10

24.   The document-image recognition device as

claimed in claim 17, further comprising:

a document-image creating unit creating the

document image, in which a figure or photograph

15   rectangular area separated by said classifying unit is

painted over with a specified color;

a binarizing unit binarizing said document

image; and

a character recognizing unit recognizing

20   characters on a binary image obtained by binarizing said

document image.

25

25. The document-image recognition device as claimed in claim 17, recursively carrying out a process performed by said classifying unit to a specific rectangular area classified by said classifying unit.

5

26. A document-image recognition device

10 recognizing a document image, comprising:

an input unit inputting said document image as a digital image;

a color area separation unit performing color area separation to said document image;

15 a binary-image creating unit creating a binary image for each area separated by said color area separation;

a binary area separation unit creating a single binary image by combining said binary image for

20 each area, thereby performing binarization to said document image, and performing binary area separation to said single binary image;

a comparing unit comparing a result of said color area separation and a result of said binary area

25 separation; and

an obtaining unit obtaining a binary image and
a result of area separation by performing a feedback
process until a certain condition is satisfied, or for a
fixed times, in accordance with a result of comparison
5   carried out by said comparing unit.

10   27.   The document-image recognition device as
claimed in claim 26, wherein said feedback process is
performed in a case in which a text line is extracted
from a range in said document image by one of said color
area separation and said binary area separation, and a
15   character rectangle including characters is not
extracted from said range by the other, said feedback
process including the steps of:
       specifying a character color of said character
rectangle;
20   determining that said range includes a
character if said character color is even throughout
said range;
       performing said color area separation, said
binarization, said binary area separation to said range
25   by use of said character color; and

performing said comparison.

5

28.   The document-image recognition device as
claimed in claim 27, wherein said feedback process
includes the steps of:

creating an area including the text line in a
10   case in which said text line extracted from the range by
said color area separation does not exist in the result
of the binary area separation as the result of said
comparison;

performing said binarization and said binary
15   area separation to said area; and

performing said comparison.

20

29.   The document-image recognition device as
claimed in claim 26, wherein said feedback process is
performed in a case in which layout features of a fixed
number or more than the fixed number of text lines are
25   continuously different between said result of the color

area separation and said result of the binary area separation as the result of said comparison, said feedback process including the steps of:

       creating an area including said text lines;

5   binarizing said area;

       performing said binary area separation to said area; and

       performing said comparison.

10

       30. A record medium readable by a computer, tangibly embodying a program of instructions executable

15 by the computer to carry out a document-image recognition process, said instructions comprising the steps of:

       a) inputting said document image as a digital image;

20   b) specifying a background color of said document image;

       c) extracting a plurality of pixels located outside a background area from said document image by use of said background color;

25   d) creating a plurality of connected elements

by combining said plurality of pixels; and

e) classifying said plurality of connected elements into a plurality of fixed types of areas by use of at least features of shapes of said connected

5   elements to obtain an area-separated document image.

10   31.   The record medium as claimed in claim 30, wherein said instructions further includes the steps of:

f) creating a binary image by binarizing said area-separated document image;

g) classifying a plurality of areas included

15   in said binary image into said plurality of fixed types of areas;

h) comparing a result of the step (e) and a result of the step (g);

i) correcting said area-separated document

20   image if said result of the step (e) is not equal to said result of the step (g); and

j) recognizing a character in a text area of said area-separated document image.

25

32. A record medium readable by a computer, tangibly embodying a program of instructions executable by the computer to carry out a document-image recognition process, said instructions comprising the steps of:

a) inputting said document image as a digital image;

b) performing color area separation to said document image;

c) creating a binary image for each area separated by said color area separation;

d) creating a single binary image by combining said binary image for each area, thereby performing binarization to said document image;

e) performing binary area separation to said single binary image;

f) comparing a result of said color area separation and a result of said binary area separation; and

g) obtaining a binary image and a result of area separation by performing a feedback process until a certain condition is satisfied, or for a fixed times, in accordance with a result of the step (f).